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Frank Malina, Artist and Scientist : Works from 1936 to 1963

Introduction

Art and Science, " figurative " and " abstract " art, daylight and artificial light, virtual and real movement, geometrical, surrealist or realist subject matter - all these problems and relationships have occupied Frank Malina, the American artist who in spite of his many years of activity and his courage to face such basically important aesthetic problems and proposing his personal solutions and syntheses for them has remained relatively unknown outside a narrow circle of enthusiasts of " real " movement in art.

Yet his kinetic pictures form already a very important " oeuvre " and the radical innovation operated by such an artistic undertaking deserves very close attention, particularly because, aesthetically speaking, no label can easily be attached to Malina's art. While using an interesting new technique he remains a true painter in the sense that colour and colour changes play a decisive role in his pictures.

Without participating in either the architectural tendency of " constructionist " artists who have introduced real movement into their pictures, nor following the pure " tachist " tendency, he has enriched present day art with a renewal of what one could call modern stained glass windows or, more ambitiously the pictorial equivalent on a human and familiar scale of the more synthetic theatrical or cinematographic spectacles and television.

The burning actuality of Malina's art cannot be over-emphasized: a serious attempt is made to find an adequate expression of modern man's aesthetic and scientific ambitions.

Writing about a living artist is a difficult undertaking. An art historian or aesthetician when he dissects the character and the work of a creator who has ceased his activity deals with a whole. He can follow the different stages of the artist's development and is not too much concerned with the possibilities open to the artist at every moment of his career. He can neither be criticized by the artist himself nor contradicted by future developments. This handicap becomes more serious yet when the artist has a complex personality - and in the case of Frank Malina is doubled by a fully grown scientist in the same person whose activities and thoughts and works do at first sight seem quite contradictory with his artistic attitude and output.

But what are the advantages of writing on a live subject and living human beings? You have some first impressions without intermediaries; you can utilize a dialectical method, you can discuss problems with the actors themselves, but above all the human contact which yields always the precious truth can be established - a link with the past created artificially can never make you participate completely in the creative process.

In such a way a living monograph is attempted here which hopes to participate and make the reader participate in Frank Malina's work which is so close to the ambitions of the main scientific and artistic trends of our time that the antinomy of the individual and the collective should be abolished here.

No event in history can repeat itself exactly in the same way. But it is difficult not to search for a parallel with the great Renaissance figures in an attempt to appreciate the prodigious effort and tenacity needed in the 20th century to brook the cleavage that has occurred between science and art.

Fear of the machine that had the tendency of superseding all human endeavours, on the other hand suspicion of all values with a " spiritual " component had led to a crisis culminating at the end of the 19th Century in an almost complete divorce between scientific and artistic pursuits. It is true that at the same time the foundations for a new way of living were laid and that artists started incorporating in their works either modern techniques, or subject- matter related to science. Artists began to see that the scientific spirit could be accepted in a new artistic synthesis.

On the scientist's and specialist's side the attitude changed also. Whereas at the end of the 19th century and the beginning of the 20th, faith in progress and pure scientific and particularly mathematical knowledge was paramount, doubts and crises set in and the attempt to remain within the human orbit led naturally over new psychological experiences to the realization that art as one of the most glorious human achievements cannot be superseded by figures.

A single individual faced with such an important basic problem of our time must feel overpowered. Yet Malina has tried to grapple with it and his effort is at the same time typical and privileged in as much as he has assumed the responsibility of trying a synthesis between art and science without losing sight of the human rhythm. In order to understand this better we shall have to examine his life and character in its divers aspects before attempting a technical and historical analysis of his works and their aesthetic appreciation. But the problems involved are too extensive that we could avoid a discussion, with the artists' assistance, on the wider implications of the psychological, formal, sociological and other philosophical issues.

It cannot be denied that we have now reached a period in which the individual consciousness of the artist and the collective diffusion of his works, be they original or only reproduced, play a predominant part.

The naïve artists are only falsely innocent, in fact they show a different face of their astuteness and intelligence. The formal problems are to them as real as the means they are using in order to resolve them. Just as colour, line and composition denote as many problems to every painter, the complexity of modern life demands that such media and expressions as artificial light and movement be incorporated in visual expressions and the artist who assumes this responsibility faces these problems additionally.

Similarly the spectator is asked to make wider use of his senses in order to follow the new visual stimuli and to arrive in this way at a more complete aesthetic experience. Malina's originality lies in the fact that he makes the spectator participate in a rhythm created by an artist who is sensitive to the fundamental changes in our lives due to scientific achievements.

With this idea in mind let us now approach the beginning and growth of an individual who is so much an expression of present-day ambitions that he is typical not only of his country and his continent but of the creative spirit of our time.

Melina's Personality

Frank Joseph Malina was born on 2nd October 1912 at Brenham, Texas, a country market town in a district that was devoted to cotton and corn (maize). This hilly countryside was converted into land on which livestock is now raised. A little town of about 8 000 inhabitants, Brenham is the County seat of Washington County and holds an interesting position historically speaking, since the first capital of the Republic of Texas was established only a few miles away on the Brazos River. It is about 70 miles away from Houston, the largest city of Texas with a population of about one million, and a good number of Houstoners have elected the country around Brenham to have summer houses and ranches there.

Frank Malina's mother's family had come from Czechoslovakia, then Austria-Hungary, in the second half of the 19th century to settle in this pleasant and rich country. His mother, born in Texas, had strong musical inclinations. Piano player and teacher, she was the organist in the Lutheran church.

His father who had come to the USA from Czechoslovakia at the beginning of the century was a professional musician and it seems that he met F. Malina's future mother when they played in the same orchestra. He was a cornet soloist, played in the Houston symphony orchestra, and became later music teacher and conductor of the High School Band at Brenham.

Frank Malina grew up in these pleasant surroundings and in a household primarily devoted to music; he played the piano and took lessons on the cornet. In 1920 when Frank was only seven years old, his father took the family back to Czechoslovakia, which had been made a republic after the first world war, and stayed on in Moravia for five years. Frank went to school there, but he was already passionately interested in drawing and also in stories of balloons and aircraft. He read Jules Verne's *Voyage to the Moon* in the Czech language and this story remained at the back of his mind. (40 years later, in 1960, he proposed to the International Academy of Astronautics at Stockholm, that a committee be established to prepare for creation of a manned research laboratory on the moon for the use of all nations. He is chairman of this committee which is known as the Lunar International Laboratory Committee or the LIL Committee.) When he was back in the USA in 1925, his room was covered with drawings of pigeons, tigers and his personal heroes at the time: George Washington, Benjamin Franklin and Charles Lindbergh. A great number of aeroplane models were also assembled. Among the drawings in his room were also his favorite composers Mozart and Verdi, and although he dropped the piano playing, he took lessons on other musical instruments, finally concentrating on the trumpet. He now played together with his father in the town band : thus the father's wish that Frank should become a musician in the family tradition was nearly realized. Perhaps prepared by reading regularly popular mechanics and science magazines or recently more ambitious literature such as the *Automobile Boys* or *Tom Swift*, both of them full of technical stories which are nowadays amalgamated into science fiction literature, he decided to become an engineer. Perhaps this decision was already coloured by the readings as well as Jules Verne's, the seeds were sown for an adventurous professional career. His father must have felt that this was not just a child's caprice or dream, when he ceded and agreed to bow to his son's choice.

So in 1930 he entered Texas Agricultural and Mechanical College, a Military Boarding School about 50 miles from Brenham. But musical training served him there for a good purpose. He managed to cover his expenses by playing in the college band at ceremonies, concerts and sporting events, - and he became also the college's bugler.

His professor of technical drawing, H.C. Spencer, who was also a painter, suggested that he switched from mechanical engineering to architecture during his second year at college, but his attraction for aeronautics was already so strong that he resisted also this temptation.

He finally won his first degree, B.S. in 1934, and gained a scholarship for Graduate Studies at the California Institute of Technology at Pasadena.

Just as at the Texas A+M he earned a considerable portion of his expenses at the California Institute of Technology through the illustration of technical books and when he met Théodore von Kármán, the eminent aeronautics theoretician in 1936 at the Institute, he was asked to prepare the illustrations for the Kármán-Biot book *Mathematical Methods in Engineering*.

Thus the foundation for the double personality of Malina had been laid. In a recent interview he said " childhood determines your reactions " and his varied experiences up to 1934 had in fact determined the universality which was to follow. He was very conscious of this pre-determination as an scientist and artist. In 1953 he explained how these activities in childhood and adolescence had helped him to form a first aesthetic doctrine: " Line ", he wrote, " as used in engineering drawing, strongly permeates my being; by disposition I am strongly affected by colour; and by conviction I am of the view that a complete picture should have subject matter ".

But before determining what form the relationship or even conflict between science and art took in his life let us throw first separate glances on his purely scientific occupations and achievements, as well as on his artistic career.

The different aspects of the growth of Frank Malina's scientific personality can perhaps best be gathered by looking at his main activities in the field of engineering and natural science: rocket propulsion, aeronautics and geophysics.

The foundation of F. Malina's personality as a constructor or engineer in the more narrow sense of the word, was of course already laid in his student days at college and at the California Institute of Technology. At the latter after taking M.S. (M.E.) and M.S. (A.E.) degrees in 1935 and 1936 he became a co-founder of the GALCIT Rocket Research Project, which concerned a study of rocket propulsion. Based on his findings the first American jet propelled guided missile was produced. Malina became a co-founder of the Jet Propulsion Laboratory and of the Aerojet Engineering Corporation. In 1940, with Th. von Kármán he showed theoretically for the first time that the design of a long duration solid propellant rocket motor was feasible. After considerable research on long-range jet-propelled missiles he conceived and directed the design, construction and testing of Americas first successful high altitude sounding rocket, the WAC CORPORAL in 1945.

At the time of this intensive activity as research engineer bent on audacious inventions he continued a more academic activity as an Assistant Professor at the California Institute of Technology.

But his attitude as an engineer and the range of his inventive mind in this particular field can perhaps best be grasped by comparing his co-inventions of a more specific application, such as spontaneously igniting liquid propellants for rocket engines, a safety device in connection with the operation of solid propellant rocket motors and of improvements in methods of applying rocket propulsion to flying boats, with the discovery, together with M. Summerfield, of criteria for step-rockets which gave an entirely new impulse towards a solution of the problem of escape from the earth by rocket in 1946. Although rocket research is intimately connected with the field of

astronautics, Frank Malina's preoccupations and research in the latter led to a parallel scientific attitude which could perhaps best be described as adventurous, although he was never losing sight of the human factor. In a collection of letters to his parents, which alone would make a fascinating publication and commentary on the great adventure of rocket research and development between 1936 and 1946, Malina gives us the main-spring of the formation of his scientific personality.

The principal human influence in this development is no doubt the great personality of Dr. Theodore von Karmán whose encouragement and judgements on all Malina's projects have something providential about them. There is no doubt that the influence of " his second father " as Malina called him was both from the theoretical and the practical part of view wholly beneficial to Malina and that throughout the development of his scientific activities. Dr. Karmán, after receiving him to his home in Pasadena, never ceased to the present day to give him his unstinted help both as the great international authority on aeronautics, and as a practical participant in Malina's projects, inventions and research laboratories. Von Karmán had no doubt also a decisive influence on his pupils in underlining the importance of international pacific applications of the new science.

Malina's note in December 1944 is particularly significant, when he writes with a sense of relief " Some of the gadgets we helped to develop saved several lives in the Pacific recently. "

In a still more specific passage written after a visit to Albert Einstein at Princeton on 2nd of April 1947 when Malina was about to join UNESCO he says: " One of my first projects will be to break down the frontiers between countries to facilitate the movement of scientists and their equipment. "

Thus the three main characteristics of his scientific activity and collaboration with Dr. von Karmán appear to be an earnest, almost superhuman effort of scientific pioneering research in a particularly difficult field, a suspicion towards easy solutions and publicity and a genuine wish of peaceful application of the new knowledge for the benefits of all mankind in its struggle with " stubborn nature ".

Some of the more tangible aspects of Malina's scientific achievements in the pedagogic and international fields during this period included the publication together with Théodore von Karmán of aeronautics lessons in the " Popular Educators "; in the following year the French " Prix d'Astronautique " (prix REP-Hirsch) was awarded to Malina and in 1940 he received his Ph.D. degree in Aeronautics at Pasadena. Other awards and honours were to follow but his intense activity in this fascinating scientific field had a considerable impact on his sensibility attested by an article on visual phenomena in aerodynamics, published by him in a French periodical.

(" Phénomènes Visuels en Aérodynamique ", *Aujourd'hui, Art et Architecture*, N° 6, Jan. 1956, p. 50-51.)

Astronautics has become an integral part of Malina's personality : it is together with his artistic pursuits the most constant feature of his character.

After a temporary withdrawal from this field his activities have become more intense than ever. A historic event is at the root of this change.

On October 4, 1957, the world was surprised to hear that an artificial satellite launched by the Soviet Union was circling the earth. Malina says he paced about his studio for hours trying to absorb the implications of the accomplishment. He had thought a man-made moon was still years away. As a matter of fact, he had thought that man would first proceed in sending an object into space not to return again - in other words man would cause an object to escape from the earth's power. The first Sputnik changed greatly the work pattern of Frank Malina. He agreed to return to the work of astronautics in the field of international scientific co-operation only after the intervention of von Karmán and Andrew J. Haley, an international lawyer whose speciality is space law and who was president of the International Astronautics Federation and Malina became the Federation's permanent representative to UNESCO. In 1959 the Federation asked von Karmán to form an International Academy of

Astronautics and Karmán, in turn persuaded Malina to work with him on the creation of this new institution. Thus he became a founder-member of the Academy and its Deputy-Director in 1960.

As a geophysicist studying soil erosion problems his attention was directed to the exact opposite: from the macrocosm to the microcosm. But in a certain sense looking through a microscope or a telescope is much the same thing: after some mechanical aid given to the human eye the particular attention of the scientist is directed to the interpretation of phenomena now visible in a new framework. In any case " coming down to earth " had not only the result that Malina's eye and mind were brought to examine objects and problems at close range, but also their social and international implications. When, in 1950, he was given responsibility for leading the Arid Zone Research Programme by UNESCO the wide application of a precise scientific project must have coloured his whole personality.

Thus we see that the three main aspects of Malina's scientific attitude are imbued with the insatiable spirit of research and adventure, but above all they are directed to the greatest possible universality. Their object is peaceful international co-operation in the activities that are among the noblest of the human race: the acquisition and application of knowledge and the elaboration and dissemination of art.

This trend towards the universal and unity is one of the characteristic features of Malina's inner development as a scientist and we shall not be surprised to find these three aspects (and their general implications) reflected - perhaps in a slightly altered form - in his artistic works. But let us first continue to examine Malina's artistic and general personalities.

We have seen that Frank Malina drew since childhood and this constancy of his artistic pursuits is in a certain sense surprising, since until college days no important outside artistic influences seem to have marked him. This absence of outside influences while he was continuing intense artistic researches in the spirit of the time, is one of Malina's characteristics to which we shall have to return later.

Drawing for pleasure and drawing semi-professionally, Malina was influenced by and entered actively into the discussions that were taking place from 1934 to the outbreak of the World War at the California Institute of Technology as in other scientific educational and research institutions in America and Europe, particularly on the social relations of sciences, including the relationships between science and art.

This was a crucial period in the formation of his artistic temperament which decided permanently on the subject-matter of his later pictures and can be regarded as a true image of the conflict between the two sources of human knowledge and of the human character. In a letter to the author dated 28 December 1962 he gave an interesting account of this conflict: " At this time, " he writes, " there already existed what I will call the division between the 'classical' and the 'scientific' attitude - the division began at the time of the Renaissance. This situation is so well known I will not go into it, except to say that I am not sympathetic to the 'classical' outlook. This has meant that I have been forced to constantly struggle with the 'science-art' relationship question. " " During the period 1936-46 I was hostile to the so-called " abstract "type of pictures. The American word " non-objective " for these pictures especially disturbed me. I felt that those that used words to analyze pictures rather than clarifying their implications were " muddying the waters " and resorting to mystification and magic. Since I regard pictures as a way of communicating interpretations of the objective world, and of ideas or conceptions of the objective world it is evident that much that is written by those of a 'classical' outlook would be incomprehensible to me. Gradually I have come to accept the view that 'abstract' or 'non-objective' pictures differ from traditional pictures only in their subject matter. The subject matter of 'abstract' pictures may be geometrical

shapes and their arrangement, unfamiliar views of objects as seen from aircraft, through microscopes, attempts at picturing 'abstract' concepts of the objective world, etc. The paintings need not be copies since the artist has the power to be inventive, arbitrary, etc. 'Abstract' paintings need not have a top and bottom. They may be gravity-free, as are views seen through microscopes, telescopes, from aircraft etc. I have noticed that a picture which deals with subject matter which is not familiar to the observer will be called by the observer 'abstract'. A painting of the Champs Elysées would probably be called the equivalent of 'abstract' by an Eskimo. If my description of 'abstract' pictures is correct, then I see the work of artists as an important effort to communicate new visions of the universe as found through scientific research to the community at large. This seems to me highly desirable especially in societies where new knowledge is rapidly applied in technology. "

In this way Malina had found a first theoretical solution for the role an artist-scientist is to play in modern society, but from 1946 onwards his life and attitude can no longer be separated from his artistic activity and each work and each period that followed, enlarged the problems presented, multiplied the aesthetic elements and found a theoretical and practical new solution at every stage. This is true artistic progress coinciding with the habits of scientific thinking.

In 1953 however, he took a momentous decision; he left UNESCO and decided to devote himself almost entirely to art and in the same year he had his first one-man show at the Galerie Tronche in Paris, followed by another at the Galerie Arnaud and a still more important one at the Galerie Colette Allendy in 1955.

He was now comfortably installed in a house in Boulogne near Paris with his wife and two boys. Later he managed to build himself a separate studio where more ambitious experiments were attempted.

In fact the Paris atmosphere, his regular participation at the Salons " Comparaisons " and " Réalités Nouvelles " and the interest private galleries, art critics and collectors were showing must have encouraged him to give the greatest attention to aesthetic problems such as light and colour, although the more technical discoveries still marked periodically his artistic progression. We shall later discuss in detail the vicissitudes of his works as he introduced successively wire mesh collages, illuminations, electricity, movement and sound into his pictures. Outside recognition came by the purchase of his work by the City of Paris and the National Museum of Modern Art in Paris and he was awarded the Prix Yvonne Valensi at the Exhibition " Comparaisons ", in 1958.

We have seen that at the end of 1957 Frank Malina was induced to give again more time to astronautics and international scientific co-operation, but his art had reached such maturity that its development was not interrupted by these events.

His work pattern, however, was greatly changed. Although he devotes practically one day to Astronautics and the following day to art ever since 1958, he says that the basic difference between his activities before 1953 and after 1958 is, that whereas his profession used to be astronautics engineer and his hobby art, his profession is now artist and only his hobby astronautics.

In fact Malina's artistic curiosity has never abated and although over a hundred kinetic paintings were produced under a perfected system since 1956, he is at present experimenting in entirely new directions both on the visual and the auditive side of his creations.

He will certainly never fall into the error to persist in a personal style longer than it is compatible with an inner necessity or his artistic curiosity.

Has his enquiring mind and his aesthetic sensibility found a way to co-exist creatively in his every-day life ? Let us throw a last glance on Frank Malina's life and character before pronouncing us on these points.

In order to penetrate sufficiently deeply into this problem one would have to describe, in the manner of James Joyce, an ordinary day in the life of Malina or still better of two main characters, one representing Malina the scientist and the other Malina the artist.

Without going so far and without attempting to describe too many symbolic levels, a coincidence between life, science and artistic rhythms could be a key to this complex question.

What are the essential qualities that make us feel that Malina has arrived at a co-ordination of these rhythms ? There is the simplicity of approach to any problem whether it concerns every-day life, friendship, a technical or an artistic problem. This simplicity leads through intelligence to inventiveness. And there again a common denominator can easily be traced. This inventiveness applied by patient research showed its fruits equally in his adaptation to life and changing circumstances, scientific discoveries in great numbers and the utilization of new media such as electric light in his art compositions.

More important yet is the constant dynamism which he has shown from childhood and in his many successful activities up to the present; in science it forms the subject-matter itself of his principal field of research: conquering new worlds in space; in art it leads to the introduction of real movement in his works. Yet another principal feature and perhaps an unexpected one is his responsibility as a human being, scientist and artist, not only for his own work, but also towards other human beings whether in direct contact with him or only as scientific or artistic " consumers ". Thus the importance he places on the social application of his inventions, whether scientific or artistic, marks his third parallel attitude - one which is unfortunately rare although it remains an ethical necessity for any influential artist or scientist.

This parallelism of rhythms is, on a different level, also one of the dominant features of his artistic research. Neither in this field where the imagination knows no bounds, nor in science where human ambitions have been vastly multiplied in our century, Malina has ever ceased to apply a human rhythm.

In this way the quiet outward life he leads in Boulogne, the friends he receives there with his wife, the simple games he plays with his boys or the more ambitious chess-battles he engages in with his visitors, correspond to his most adventurous excursions into space and to his artistic sensibility and inventiveness.

A parallelism between the no-man's land lying between the simple and the phantastic in Malina's artistico-scientific endeavours and their description is perhaps not too far-fetched.

In our journey we have arrived at a biographic no-man's land where one is no longer certain whether one alludes to a name or a man.

Perhaps we can also speak of a scientific no-man's land where the alternative seems to lie between a tinkering amateur and a scientific superman, and perhaps are we also in an artistic no-man's land between the dilettantes and born geniuses.

We have arrived at a point where we can honestly say that we have consciously created a myth in order to unmake it. First it was the myth of the predestination, of the exceptional in the childhood of the artist which made him into a unique human being.

Then we created the myth of the scientist and the superman, compared by Jean Cassou wittily to the most exceptional heroes of Jules Verne.

Finally there was a question of an uncanny creator of forms and artistic techniques.

It is certain that Malina's childhood experiences, influences and aptitudes have nothing very extraordinary in themselves, yet they remind us of something that is at the same time very personal and very general. As a scientist Frank Malina is not treated quite like any other scientist by his colleagues and as an artist his position is also considered as exceptional. Does this mean that he is neither a scientist nor an artist? Not at all. It seems to me that not only in his life, but also in the fundamental traits of his character he is so close to life in general of our times that it is this particular link which is the predominant and unifying feature between his different pursuits. It is perhaps this attitude which brooks the chasm between art and science, between the artist and his public. In this context Malina could yet be made the symbol of modern man, a being heavily conditioned by scientific inventions yet conscious of the fact that he cannot live without aesthetic values.

But in order to completely dissipate the myth we have created let us turn to his artistic works. Their mediation is essential for this task, as well as for following up his actual achievements and for allowing us to form a true judgement.

Melina's Works : Period 1936 to 1963

Frank Malina's artistic venture is characterized by a long period of incubation and struggling for ideas culminating about 1953 in a breaking away from the traditional two-dimensional medium. This was followed by a series of experiments in tension, transparency, electric light and movement which were introduced at certain intervals in his works. However, Malina conducted often a parallel research in the different media and systems that he had elaborated and it is therefore important to keep in mind that the chronological order often overlaps the logical order based on the technical inventions and aesthetic preoccupations. There is also a certain persistence of the same subjects treated throughout Malina's career.

The period between 1936 and 1953 was dominated by his desire to introduce a certain symbolism and subject matter from modern science, that is to say technical objects as well as scientific ideas into his art. This starting point was briefly intellectual as would be expected of someone whose mind was used to participate actively in the rearrangements of sense data. In the pastels of the early period the observation of nature was still dominant. There subsist a few landscapes and colour studies from nature, especially a green chess knight (1941). But very soon the desire to introduce more complex scientific ideas or observations became apparent, mathematical formulae are noted on the pastels, sound waves, and rockets appear clearly defined as subject matter. There are even comparative allegories: half the picture kept in vague forms and diffused light and washy colours representing the uncertainty of metaphysical thought, whereas the other half with clearly defined outlines and colours symbolizes the merits of the precision and intellectual honesty of modern science. Another pastel is a juxtaposition of the known and unknown universe, symbolized by the opposition of dark and light forms, but especially by a hymn in praise of the exact achievements and discoveries of science.

These pastels are often monochromatic studies, that is to say all variations are noted by the addition or subtraction of white from the colour chosen.

The great variety of subjects that are in constant competition in the artist's mind are always closely linked with the preoccupations, constant or passing, in Malina's life.

For example dotted lines are introduced to show the outlines of invisible objects, a process employed in engineering drawing, which in the new context takes on an ornamental value, based on an intellectual reasoning.

Classical Art theory has the tendency to interpret the growth of the artistic personality from a representation of what one knows of an object to its visual appreciation and stylisation. This theory has had some serious setbacks. An artist like Klee managed for example to arrive at such a mixture of these intellectual (or naïve) elements and the stylisation of the sensual observation that his works became magically poetic while their substratum of ironic mental commentary on this vision persists not only in the title and subject matter but in its synthesis with the form.

The elaboration of in what would seem a naïve way of the subjects in Malina's early pastels could therefore be compared with Klee's subject matter and the research of a pictorial representation of simple ideas and conceptions are not only the privilege of the child, but also of the artist who is transforming a concept as simple (and as complicated) as $\sqrt{-1}$ (root of minus one), one of these pastels, into coloured language.

A great number of these subjects will reappear after 1953 in Malina's work when he will be introducing new dimensions and new media into his work.

An allegory between the stable, unstable and dynamic announces his researches in motion, the ever recurring Bunsen burner or the electric lamp an ever growing interest in incandescent energy and the actual introduction of electric light.

Classical subjects such as the nude, street scenes etc. are treated in a scientific way : the interest is mainly on foreshortenings, the airview of cross sections, or the structure of natural objects.

On the purely aesthetic side, apart from visual experiments in direction and sequence, the opposition of dark and light (black and white) is followed by an interest in the transparency of colours by superposition. Pastel is an ideal medium for this research and Malina during the whole of this period gives it his preference.

The harvest of this period of assemblage and preparation of ideas and styles is rich, several hundred small-size pastels and gouaches show the variety and range of Malina's " prise de conscience ". From the most simple subject, children's toys, to the most complex, an allegory of the structure of nature including the mathematical calculations involved, from the most rational, the golden mean represented by a logarithmic spiral, to the most fantastic - a spiral with eyes - we find a bewildering variety. This bewilderment is not due to a confusion in the artist's mind but rather to its profusion which will be cristallizing around some major themes in the succeeding periods.

While this period remains characterized by an inner struggle for transposition of scientific subject-matter into visual images and an intense experience in two-dimensional media, a synthesis or progression is made in which the naïve or rather ironic and playful element is fortunately not absent.

In one of Malina's pastels of the period a monkey is sitting in the center of his picture contemplating life dominated by a motion probability curve. Whatever sarcastic, humorous or even profound comments the symbolism of this picture may engender in the observer's mind, Malina would be the first to appreciate and share it with the commentator.

The turning point in his artistic research, however, is marked by another kind of animal, a chess horse, which will be the first work clearly illustrating his interest in the third dimension: his studies in tension are about to start. This is the transition from the period of contemplation and trial to that of research and synthetic realisation. When, in October 1953, Malina had his first one-man show at the gallery Henri Tronche, 6, Avenue Percier, in Paris, 8, he exhibited side by side with two-dimensional works constructions in which the application of materials, string, rope, wire and wire screen had been used to obtain pictures having a character of coloured relief and structure.

In a pictured pamphlet he explained the evolution as follows : " In a flat oil painting of a chess horse several backgrounds failed to enhance the horse. The question came to my mind: 'Why a background?' The painted outline of a chess horse was then suspended by a string structure inside an ordinary picture frame. This had some appeal, and the next question was why not to omit the painted object and make a picture in which line was of painted string. The first ones of this type were constructed in such a way that the lines went into or came from the frame, and necessarily led to a pattern made up of straight lines, as string has no inherent rigidity." Thus the first important step in transforming an aesthetic impatience with the two-dimensionality of painting was realized, the beginning of a new technique with the help of a new medium was made and a relief or structure was formed. A further step was the introduction of metal wire which could be modelled. However the pattern still had to be supported by attaching lines to the picture frame. A new development was the attaching and stretching of lines by flexible or rigid material on a wire mesh extended between the frame. This new arrangement allowed a much greater flexibility in the composition of the reliefs. For example curved forms could easily be introduced and enabled Malina to break with the rigidity of the previous constructions.

But a much more important step had now been taken: a certain transparency had been obtained by the adoption of materials fitted into a multi-planed arrangement. The plastic possibilities were further enhanced by using colour not only for painting strips, but also by squeezing oil paint through the interstices of the wire meshes. Other variations of this theme were obtained by slices or cut-outs in the wire mesh which let the colour of the back panel participate in the composition, roughly in the manner of the Italian painter Fontana in his monochromatic pictures, who slashes the canvas with a knife, breaking the monotony with a plastic and symbolic effect.

One of Malina's wire collages was acquired at the " Salon des Réalités Nouvelles " in 1954 by the City of Paris and is exhibited at their Museum, in Avenue du Président Wilson. Entitled " **Deep Shadows** ", it is a study in luminosity and darkness by superposition of layers of wire mesh in different textures.

This preoccupation with materials and techniques changed of course radically the outward appearance of the subject matter of Malina's pictures. A superficial observer could paradoxically say that this composition had become " abstract ". The formal elements had of course taken a much greater importance in the new constructions aspiring at the third dimension and in this way they followed the trend and repeated the history of non-figurative (" abstract ") art. The real subject matter, however, was still the world as seen by science : for example, one of Malina's early string pictures shows a clear resemblance with cosmic ray showers. The relationships between the outside world, especially if it is an unusual and stimulating one like the scientist's world as seen through microscopes and telescopes, and its reutilisation by an artist, are very complex. But there can be little doubt that in the case of Malina these relationships are ever-present and form one of the most constant elements in his art. It is not surprising that for him the distinction between " abstract " and figurative, or representational and non-representational has little meaning.

A last element was introduced by Malina in this phase of transparency and use of multi-planed media in the form of moving fields of lines, or what he called the " fringe effect ". " As the observer moves, multi-concentric circles radiate in an unexpected manner in different directions. This " virtual " movement is in subtle contrast with the geometric pattern of the wire meshes and gives an added interest to the sensation of transparency. The fringe effect is obtained from superposed layers of wire mesh, but two disadvantages became soon apparent. The first one is that the fringes were in some positions of the picture " out of focus ", which proved to be disturbing to the observer and the second that the contrast obtained between the fringe lines and the background was not sufficiently stressed. The Argentinian artist Jesus R. Soto who has been experimenting with this kind of

movement for many years finally overcame this difficulty by painting a mesh on two parallel transparent plates or by suspending fine metal constructions before a painted background of parallel lines.

The aesthetic development during the whole of this period of technical research in different media is dominated by the discovery of the third dimension and more particularly by the different ways of producing and elaborating artistically the transparency of the pictures.

We have already alluded to one of the very first string relief pictures of Malina entitled "**Cosmic Ray Showers**". In this work the string structure is placed within an old-fashioned frame, which is painted in order to match with the composition.

The observer has little difficulty in apprehending that here the artist's intention had been to give a feeling of tension, underlined mainly by the direction of the various string arrangements. This feeling as communicated to the observer is based on an original impression by the artist of this phenomenon and as he remarks himself, he "was not conscious of the fact that it represented anything special".

It was a Harvard physicist, Dr. Schringer, who recognized that the composition reproduced a definite pattern seen in cloud chamber photographs of cosmic ray showers and Malina agreed that this construction must have been suggested to him by these photographic images.

This interesting property of the human mind to store up memories of subject matter combined with images and, in the case of the artist, to reproduce them in a variety of forms with a new purpose - in this case to underline the aesthetic possibilities of tension - works in a yet more fantastic way if colour is made to participate in this quest. In the picture we are discussing the highly coloured strings, mainly in red and green, give to the graphic element a different feeling and a different appearance than coloured lines painted on a flat canvas.

"**Cosmic Ray Showers**" is a study in tension where lines are transformed into coloured strings, reproducing one of these mysterious phenomena of scientific research which is the particular world of this artist. It is an important land-mark in Malina's evolution and domination of the aesthetic media used for interpreting the third dimension and the aesthetic possibilities of transparency.

Another picture constructed a little later in the same year of 1953 is entitled "**The Family**". It contains wire and string figures of a mother, a father and two children on a background of children's paintings. This is an expression of another side of Malina's versatile character: he wants to comment on aesthetic tendencies of his time, perhaps slightly criticize them, but mainly experiment with his own hands everything that corresponds even to a passing curiosity, of his time. The background pictures in "**The Family**" he copied from his three years old son's drawings. Malina says that he does not share in the admiration of the primitives and thinks it a dubious approach if mature painters imitate children's drawings. However this may be, in this picture the contrast between the children's drawings used like a collage in the background and the continued research in tension and the physical exploration of the third dimension gives a satisfactory, if slightly ironic aesthetic satisfaction, something like a Dubuffet picture seen and interpreted by Reichel or Klee, taking a pretext from nature and transforming it into a poetic or spiritual symbol.

Malina's mounting interest in transparency can well be seen in a picture entitled "**Light Globe**" consisting of wire mesh with enamel paint in the interstices.

In this glorification of the electric light bulb, yellow patterns repeat the basic motif of the syne curve, a standard representation of an alternating current flowing in a wire. On the other hand, the picture is constructed with wire cable, describing very pleasant curvilinear patterns, and one has a definite feeling that real electric light, aesthetically pleasant, is about to come on there and then in substitution of the idea of photons actually represented.

In any case an apparently geometrical composition, based rather on curves than on straight lines gives the impression of fluid and foreshadows already at this stage Malina's concern with light and movement. A further aesthetic development, with a corresponding technical one in its wake, can be discerned in pictures such as " **Buildings on Lake Shore** ", " **White Vertical Lines on Blue Background** ", " **Red Lines with a Blue Outline against a Blue Green Background** ", or " **Boy's Head** ", the latter being a special example for this new technique. The main difference of these pictures from the previous period is that Malina now uses paint in a different way, squeezing it through the wire mesh and obtaining colour relief effects. Either enamel paint or, as in the case of the " **Boy's Head** " oil paint with Spanish white are used. Wire and string for graphic effects are now totally omitted. The pictures of this period develop more than anything the idea of transparency, not only in a pure visual acceptance of the term but also intellectually. To the previous interest in line, a new interest in structure is added, in particular the inner structure of atoms, crystals or leaves: generally structures that are not normally visible to the naked eye. This is an artistic attempt to see through the surface of things, at the same time giving the spectator a pictorial feeling of the structure of the object. This is Malina's version of the reality of things, a simple approach to nature without imitation, but also without consciously wanting to find a parallel between the structure of the universe and psychological structures. However, without adhering necessarily to the thought of phenomenologists, Malina uses colour in such a way that a subject-object relationship is established and that even geometrical and purely formal constructions like the white or red lines on their blue or blue-green background become more than an objective statement - they are always expressing an underlying human experience.

Another aspect of transparency appears in Malina's use of collages. His picture entitled " **Transparent Sinusoidal** " made in 1954 is a structure of several layers of wire mesh, painted mainly on the top layer. The colour is laid on in rather geometrical patterns not necessarily following the texture of the wire meshes. Although there is still a certain feeling of some science subject-matter left, the stress lies here on the ornamental effect of the texture and its interplay with the design or composition in colour on the top surface.

This effect is still further developed in a picture like " **Circle Transformations** ", which can be regarded as one of the first definite attempts of Malina to produce the sensation of movement in the spectator by utilizing what he has called the " fringe-effect ". In other words the observer sees different shapes as he moves in front of the picture. This is similar to some mathematical methods, for example that of " conformal transformation " used in aeronautics. Roughly speaking, this method consists in taking vertical and horizontal lines in one place to perform a mathematical operation, into another place and transform them into circles. That is what Malina has attempted to show both as an idea and pictorially: to transform horizontals into circles representing celestial bodies. Here too Malina has thought of a landscape having certain aspects of reality that is generally invisible. Similarities in colour with the essence of a landscape can be discovered, but in this first attempt to add movement to transparency Malina remains true to his previously confessed artistic purpose: to find a visual representation for such abstract or " scientific " matters as the magnetic fields around the earth.

In other words he attempts to transform knowledge into visual statements, taking good care to eliminate from our thoughts the word " strange " when thinking about or seeing scientific matters. In this period he wishes more than

ever to prepare our minds so that we may no longer feel any antagonism to science when looking with a critical eye at its aesthetic equivalents.

The difficulties encountered with while experimenting with layers of wire meshes and his constant concern with transparency and illumination had a salutary effect on Malina since in desperation one day in 1954 he placed the layers of mesh in front of an electric light bulb and, to use his own words, " saw a new world ".

Malina's first attempt to incorporate electric lights into a picture frame came to grief because he used lamps of too large a wattage, whose temperature inside a wooden frame became excessive and charred the wood. He gave up the attempt to use electric light for several months. After Christmas 1954 while taking down the Christmas tree in his home it occurred to him to try the string of lights on the tree. The result was his first illuminated wire mesh collage. He spent many hours looking at this picture without being able to arrive at an assessment of its possibilities. A month or two later he showed it to Sandy Koffler, the Chief editor of the UNESCO Courier, who reacted to it with great enthusiasm and encouraged him to press on with this kind of work. He then made a series of " electro-paintings ". A number of those pictures were shown at an important one-man show at the Colette Allendy Gallery, rue de l'Assomption, Paris, one of the pioneer galleries for abstract and experimental art. The show took place in July 1955 and Michel Seuphor in a preface to the exhibition gave his impressions of the electro-paintings in the following words " Féerie et charme, mais dans un langage d'aujourd'hui ". The main aesthetic innovation, namely the use of electric light in art, he saw in a subtle and poetic way : " car il y a une lumière pour le jour et une lumière pour la nuit ".

Among the pictures shown the " **Lighted Mesh Collage** " was the first picture Malina built already with the location of the light bulbs in mind. In this construction artificial coloured light took the place of painting. This was a moment in the artist's career when a courageous choice had to be made aesthetically as well as technically. After experimenting intensively with translucent coloured cellophane and the colour and light relationships in general, he opted for a technique and an aesthetic effect comparable to those of stained glass-windows. Instead of using glass and lead he chose a much freer technique: changing the wire mesh layers to form any desired shapes unhampered by lead lines. Opting for electric light was of course an important decision, because Malina now broke with traditional colours and was limited to show his pictures in conditions that resembled to the cinema or television. However, the gain was considerable as he could return to directly transmitted light as opposed to light reflected from opaque surfaces as in traditional painting. Robert Vrinat saw very well in another preface to the Colette Allendy exhibition these advantages and disadvantages, as well as the future possibilities of using real movement.

" En ce qui concerne la première (la lumière) ", he writes, " il (Malina) écarta délibérément les sources lumineuses extérieures au tableau . . . il conçut donc des oeuvres, comme par le passé à plusieurs plans peints superposés, mais éclairés de l'intérieur par des sources lumineuses disposées entre ces mêmes plans. Ce faisant, il déplace évidemment certains facteurs traditionnels de la peinture; par contre il conquiert de nouvelles richesses. . . Une nouvelle qualité apparaît : celle du matériau translucide lui-même, animé par les sources lumineuses ; et les premières réalisations prouvent le champ infini qui s'ouvre ainsi à l'artiste. "

But apart from the choice in form of artificial light and its many possibilities, including movement, the period of electro-paintings was an experimental phase which taught Malina a considerable amount about the transparency of colour and the use of translucent surfaces.

It is quite a surprising phenomenon that Malina knew nothing about pioneers in the art of light, like Thomas Wilfred, the American artist of Danish origin whose experiments with light and colour apparently go back to the

year 1905. In 1919 he designed the first important instrument for the performance of silent visual compositions, naming it the " **Clavilux** ", and the new art form " Lumia ". The first public recitals on this kind of colour organ were given in January 1922. Only in 1959 Malina learned of Wilfred's work and went to see his " **Counterpoint in Space Op.146** " which had been acquired by the Museum of Modern Art in New York the previous year.

These independent developments which are due to general ideas and tendencies that are in the air during a whole period can also be explained by a causality that is in the creative process itself. In the case of Malina and at the point of time we have arrived at, several new technical possibilities in the media he was working with presented themselves, and led him, as of necessity to introduce a new factor in his pictures. Working with light imposed a new way of resolving the problem of unification and diffusion of the moving coloured forms; the wire mesh surface that had served that purpose so well until now was no longer considered satisfactory.

Malina introduced a diffusing screen of glass, later of plexiglas, in his pictures, but kept the wire mesh in front of the diffusing screen for a while in order not to lose the texture effect. This effect was described by Jean Cassou in these words : " Le grillage imposait aux couleurs un cloisonnement comme à des émaux, et à l'ensemble une sorte de subtile vibration ".

Shortly afterwards Malina conducted experiments with superimposed layers of coloured cellophane. Finally, a new and more decisive step was taken quite naturally by Malina now working intensely with electricity: envisaging the possibility of adding time as a pliable factor to colour and form in his pictures. In the spring of 1955 he made his first mobile electro-painting utilizing thermal interruptors in the light circuits. In this type of picture one or more light bulbs go on and off at intervals of one or more seconds, illuminating different portions of the picture. Here it is only light itself that moves, instantaneously as far as the eye is concerned, so that the sense of movement which the observer feels, results from the animation process of seeing portions of the painting in a time sequence.

These mobile electro-paintings or " tableaux mobiles " with on-off lights created a certain randomness in the picture. This was Malina's first step to introduce something like a cybernetic method into his art. The basic assumption that the hazard could be utilised for artistic purposes and be controlled by the sensibility of the artist rather than by mathematical methods, is an idea that belongs entirely to the Twentieth Century. The underlying assumption is however that a sort of basic rhythm could be found for each arrangement of shapes, colours and constructions which would form the uniqueness of the work of art in spite or rather because of the metamorphoses the single pictorial elements are undergoing.

The French critic Michel Conil-Lacoste described the first impression and the functioning of a mobile electro-painting with on-off lights entitled " **Jazz** " as follows : " Onze alignements d'yeux, correspondant chacun à une source lumineuse colorée qu'allume ou occulte périodiquement un minuscule interrupteur thermique ". The functioning of this kind of picture can easily be calculated and gives 2048 possible combinations (2 to the 11th power) with its corresponding aesthetic effect. This is an important stage in Malina's desire to arrive at almost infinity in the possible combinations he is proposing to the spectator and in reproducing the life rhythm in his pictures. This is the first picture of Malina where the technical research and the subject-matter is equally matched by a new and surprising aesthetic effect that, while still bearing a definite relatedness with the world we live in, opens up a vista of another, Malina's particular world.



Frank J. Malina

"Jazz", 1955

Kinetic Painting

50 cm x 77 cm

In another mobile electro-painting called " **One Plus Two Triangles** " the movement is also given by groups of light that come on and go off, illuminating triangles of different colours. The geometric picture, or rather four different pictures are seen, by the spectator in time. This picture, shown at a group show at the Colette Allendy Gallery in 1956, marked a further step in Malina's evolution in finding an aesthetically satisfying solution for associating movement to light in his works.

The question of rhythm, tempo, cadence, measure, speed is a fundamental one in the understanding of the time factor and movement in general in art.

I cannot go into this problem in detail within the frame-work of this study, but in order to describe roughly the atmosphere in which Malina introduced rhythm and continuous movement into his pictures let me quote from a current philosophical dictionary as to what is at present understood by the terms of rhythm, measure and movement.

" Rhythm ", we read, " is the periodic character of a movement or a processus ". This implies that there is no uniformity, but that we pass from greater intensity, or speed, etc. to lesser intensity or speed, in other words that there are maxima and minima. On the other hand if we distinguish between rhythm and measure in poetry and in music we find that the rhythm does not necessarily consist of equal parts of time or cycles as is the case for measure. From this variability based on artistic necessity within the framework of regular recurrences it follows that the rhythm can be regarded as belonging to aesthetic creation, whereas measure is nothing but a mechanically applied formula .

Without making a clear distinction between the term " motion " (generally applied to mechanical displacement in physics or observed change of position of an object in space in psychology) and the term " movement " sometimes only restricted to muscular movements of a living organism, but more often loosely applied to all displacement in space, let us recall another dictionary definition : " Movement, in a literal sense, signifies the continuous change of position in space, considered in relationship to time and, consequently having a definite speed. " The concept of time is therefore of primary importance and a mere change of position cannot be regarded as movement.

Let us now look at more recent art history in order to ascertain the importance of the integration of the time factor in the form of movement, first by representation then by introduction of the real movement into the arts.

A decisive step, probably under the influence of the cinematograph whose first perfected showing was given in 1895, was accomplished in traditional painting in the first years of our century. The first of the manifold possibilities of rendering an image of movement is by introducing it as subject-matter, for example by a car or a wheel; or its allegoric representation (Hermes clad as the messenger of the Gods). An intermediate way to represent time is by successive pictures as in the Romanesque Frescoes.

On the other hand there are the various methods to represent movement by the formal element of a picture, for example by colour juxtapositions that give us the feeling of vibration, as in the Impressionist pictures, or the way to oppose the "valeurs" (lights and shadows) as in the graphic arts, the "lignes de force" that give a feeling of tension, or, in composition, instability which is yet another way to make us perceive the movement.

In the first case, that of subject-matter, the great innovation was made by the Cubists, Duchamp, and the Futurists to introduce multiple views and a figuration of speed, in the second, Robert Delaunay with the formal element "colour" in his "contrastes simultanés" and his "disques", managed to underline the importance of movement without completely breaking with the traditional methods.

An issue of this method is one of the "kinetic" currents still very much active today: the emphasis is laid on the purely "visual" aspect of movement and the spectator is invited to displace himself parallel to the picture or by a vertical movement (by bending) in front of the picture in order to introduce the time factor (Vasarely, Soto, Agam, etc.). Malina's fringe-effect pictures fall into this category.

Actual movement was introduced by pioneers such as Tatlin, Gabo, the "ready-mades" of Duchamp and Man Ray from 1913 onwards, followed by Calder and nowadays the Swiss Tinguely and others. Here the objects can vary from the glorification of the modern machine to an ironic or poetic commentary on it.

A utilisation of the natural elements to produce the movement in the tradition of Calder's mobiles is practiced at present by artists such as Le Parc and Mack (Air), Kosice (water) and Aubertin (fire).

The introduction of light and real movement or what could be regarded as the new tradition of Malina's artistic current, saw pioneers like Wilfred with his "Clavilux", Scriabine with his colour projections accompanying his Prometheus-Symphony and Moholy-Nagy with his "Lichtrequisit" at work. But none of them, with the exception of Wilfred who perfected his art of "Lumia" pursued their experiences in a methodical way and Malina, ignoring these attempts, passed from the utilisation of artificial light to its incorporation in painting in the form of continuous movement with nothing but his previous artistic and scientific experience to guide him.

His first idea was to introduce electronic methods for this purpose. He found a young engineer specialized in this field, Johnny Villmer, to cooperate in this research. Malina and Villmer first tried to introduce a variable intensity of light into the mobile system, but without any practical results, although they later found out that this could easily have been done with Thyrostron tubes. Malina was very anxious to use some kind of electronic system, but learned that with high wattage it was rather difficult to do so, especially if he wanted to reduce complexity, size and cost to a minimum. He and Villmer finally decided, with much reluctance, to attempt the construction of an electromechanical system in order to introduce continuous movement in the pictures.

The result of this research was a four-component system to which Malina gave the name of "lumidyne" and he produced the main body of his work with it from Spring 1956 to 1963.

The four parts of this system are the lights, the motor-driven movable elements (motors), a transparent plate (stator) and a translucent diffusing screen.

For the illumination Malina used essentially fluorescent tubes and incandescent lights mounted on a backboard. No coloured tubes were utilized since the difficulties of replacement would have been too great for the future owner of this type of picture and could have induced him to alter the colour disposition conceived and perfected by the artist. One of the major aims of Malina on the practical side was to find a system that had all the characteristics of light and continuous movement without having to use too complicated a means which in turn would require an expert for the maintenance of these art objects.

Another way of utilizing the white light incorporated in the picture was to fix mirrors on the backboard which sometimes reflected the light towards the diffusing screen.

The principal task for the artist in this type of lighting arrangement is, however, to find the exact location of the lights so that they match with the composition.

But since we have mainly direct transmission of light the picture is above all determined by the paintings on the stator and the rotors.

The driving system for the second element of the lumidyne system, the movable disks called rotors, is like the lighting system fixed on the backboard. In the smaller pictures only one rotor driven by a small electric motor is used, whereas in the larger pictures several rotors are driven by as many electric motors. The rotating disks (rotors) are made of transparent material, generally plastic, which are painted on either by transparent colour (vernis gras) or with opaque paint, generally following a previous design.

As to the speed at which the motors are turning Malina has found that a combination of speeds from one turn a minute to one turn every two minutes gave the most satisfactory results.

The motor arrangement gives Malina a variety of possibilities. If several motors can be made to turn at different speeds, they can also be made of different diameters and thereby produce " local " speed effects according to the distance at which the coloured form is placed from the centre of the rotor. If a greater variety yet is desired the rotors can be made to overlap. Malina has always the desire to remain in complete control of his means and generally avoids the introduction of too many variable sub-elements into the movement factor. The most complex movement he has introduced so far in the lumidyne system is in the picture " **Changing Times** ", acquired by the Lyons Museum, where two large rotors overlap by about a quarter of their area and create a complex yet well-controlled movement.

The visible movement, however, is mainly determined by the opaqueness or transparency of the portions of the rotors and the stator.

The latter is, as the name implies, a fixed plane, plate or sheet of transparent material (plexiglas or any other glass). Its main function is to hold the principal composition of the picture. Opaque paint is used to cut off light, and transparent oil paint for the rendering of strong colour effects.

It is, of course, necessary to integrate the painting of the rotors with that of the stator in order to achieve the kind of movement aimed at by the artist and although the potential changes or transformations will always have to be kept in mind, this mixing of colours resembles closely to the working process of a traditional painter with his palette and his canvas.

The equivalent of this canvas, in Malina's pictures, is the diffusing screen. Already used with his "electro-paintings" this is a glass or plastic sheet placed at one to five centimeters in front of the stator plane, on which all the technical arrangements previously described become visible. This sudden transformation of complicated mechanical devices into perceptible, coloured forms moving at a certain rhythm have induced some observers and critics to speak of " magic ". Needless to say that such an expression does not please Malina who sees

nothing supernatural in this transformation from the inner structure to the outward appearance of natural objects, one of the principal aims of his art.

The diffusing screen on which the changing images appear can be made to increase or decrease the " valeur " (light and dark) by using either mat or shining surfaces or by blackening the glass.

Another way of reducing the milkiness of the diffusing screen is the retention of a layer of wire or plastic mesh on which a uniform dark or a painted colour is left.

The main features of the lumidyne system are the judicious combination of the four (or five) elements forming the work of art, the spacing between these elements which could become the essential factor in the final composition, and the fact that, with a very nominal power input, these narrow boxes can still be hung on a wall (or if murals, worked into the wall). In fact this cinematic art remains intimate and at a human scale, closely linked to painting in its effects and application.

The subject-matter of the pictures of the lumidyne period, Malina's principal works, is still dominated by the unseeable scientific world. But equal importance is now placed on colour and colour transformations by the use of various light sources, resulting in a variety of movements of multiple aesthetic intentions.



Frank J. Malina

"Point Counter Point", 1956

Système Lumidyne

57 x 57 cm

The very first lumidyne picture " **Point counter point** " shown at the Salon des Réalités Nouvelles in Paris in 1955, contains the idea of making spatial orbits and the coming and going of stars visible. In the lower part of the picture a human rhythm is introduced symbolising people on the earth moving at their own speed. One is struck at once by the wide range of colours in this composition, due to the fact that both rotor and stator are painted and that apart from the mobile local colours new chromatic combinations are produced by the interaction of the different "lumidyne" components: for example a yellow area on the rotor passing before a blue shape painted on the stator will be seen as green on the diffusing screen. The recurrence of colours in this particular picture is from about 2 to 2 1/2 minutes, but this cycle is difficult to find since the movement is rather complex. Although the colour scheme has some affinities with natural hues, a strange other-world blue in the sky, yellow for the stars and brown for the earth, the main chromatic fascination lies in the superposition of these colours, which has less a blending than a merging effect. Some artists have experimented with dominant colour cycles, for example half a cycle with a predominant blue, another half cycle of red, etc. Malina in this first lumidyne picture is aiming at a great variety of colours following each other as in a symphony where different instruments or groups of instruments take up, one after another the melody or the motif.

Already in this picture a surprising variety of movements take place, similar to the movements in our world. They go in all directions: the rotor turning clock-wise, this direction is sometimes predominant, but a counter-clockwise direction can as easily be impressed on the picture. In addition points of lights go up and down, and also sideways. Thus a surprise effect can be created by yet unseen forms coming in from the edge of the picture. The speed of the movement is also very varied: although a shape or a point painted on the outer periphery of the rotor would be moving faster than a point half-way to the centre. It can be made to move more slowly by the way it is painted.

In " **Point Counter Point** " all the aesthetic possibilities of the lumidyne system are already present: variety of colours, variety of movement and of subject-matter.

As to the latter there are three main recurring themes, giving often the impression of three different styles, geometrical shapes, the human figure and astronomical or astronautical objects.

In a picture called " **Geometry I** " a very slow movement is employed which in fact is at first hardly noticeable at all. This picture, as the title implies, is dominated by large geometrical shapes giving off various luminosities. It was made at the suggestion of the Stockholm art collector Arenberg who had been wondering whether the transformation of geometrical shapes could be effected. Malina thinks that he has not quite achieved this but that he managed to resolve some of his proper aesthetic problems. In this picture the colour is not obtained by painting one of the components (stator or rotor) but by using several layers of overlapping cloths which give the shading. Changes take place on a red and blue trapezoid. On the rotor two yellow trapezoids cause a green area to appear on the blue trapezoid. The red on the other hand is so bright that the yellow passes behind it without the observer noticing a colour change. Yet there is movement in the red area too, caused mainly by its own colouring and the optical effect obtained by placing the red close to a grey. " **Geometry I** ", a picture made in 1961 is a striking study in colour, light and intensity, its very slow movement has a stimulating effect on the observer. The artist too made some basic formal discoveries with this picture and applied them in his future works.



Frank J. Malina
"Geometry I", 1961
Lumidyne System, 80 x cms

925/1961. Collection Malina.
Boulogne-sur-Seine

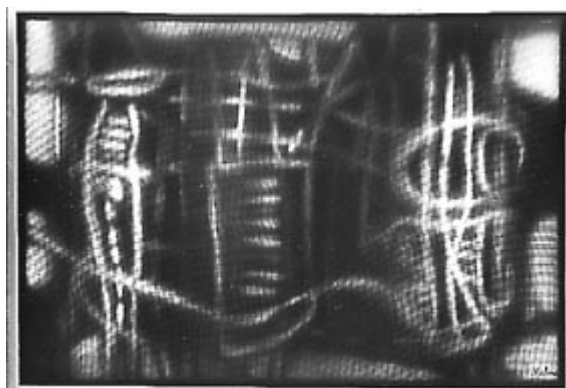
A lumidyne picture of quite a different subject matter such as " **Two Figures** " stresses the graphic element and reduces the importance and strong effect of colour considerably. A linear type of figure drawing is at the basis of this kinetic painting which is Malina's first " figurative " picture made with the lumidyne system.

The female figure on the right, whose head and upright arms vanish and disappear, is facing a more mechanical form. Both are placed in front of fluorescent tubes and although the colour transformations are of smaller interest here, the movements of the two figures resemble a fantastic dance, at once ritual, animal, human, and mechanical.



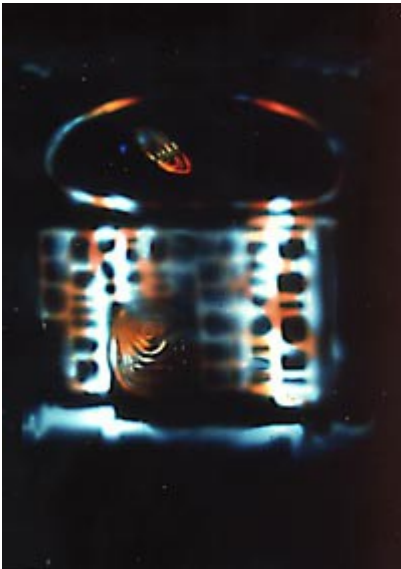
Frank J. Malina
"Two Figures VIII", 1968
3 Component Lumidyne System
60 x 80 cm

Another lumidyne picture entitled " **Changing Times** " won the Prix Yvonne Valensi at the Salon " Comparaisons " in 1958 and was acquired by the Lyons Museum. It belongs also, for its subject-matter, to this world of changing human forms. These metamorphoses could equally well be occurring in a mythological, aquarian, enchanted, or scientific world. The French critic René Deroudille felt these correspondences when he writes: " Derrière le grillage, l'écran illuminé de couleurs présente trois formes principales verticales empruntées peut-être au monde de la forêt, animées lentement par le mouvement du 'rotor', tandis que des ondes glissantes et légères comme des lianes ou des algues semblent relier entre eux ces spectres enchantés. " (in the *Bulletin des Musées Lyonnais* , vol. II, N° 3, 1958)



Frank J. Malina
"Changing Times", 1958
Lumidyne System
80 x 120 cm
Photographie de Marc Vaux

Malina in his lumidyne pictures, gives us a surprising display of pure geometric forms and of the symbolic or fantastic interpretation of human figures, but he is particularly in his element when he takes an interstellar kinetic experience as his starting point.



Frank J. Malina
"Orbits 5", 1962
81 x 62 cm
Collection Bob Robertson
Houston Texas
930/1962

"Orbits V" made in 1962 is one of these pictures where the astronomical or even astronautical subject-matter corresponds obviously to a personal experience of the artist. The attention of the observer is at once directed to a big red orbit in the upper part of the picture. Internally, along some narrower orbits three small blue planets appear now and then. Below is a network of moving red and white light. The colours are limited but striking and the red is predominant, but the interplay of the slight changes in red and black, as well as the recurring appearances of the blue planets give us a feeling as if we were traversing the universe at a pleasant rhythm.

The great variety of lighting effects and of movements are here at culmination point. Incandescent lights whose filaments are sometimes directly observable, alternate with fluorescent tubes. In addition to this directly transmitted light the observer perceives another quality of light in the form of a strong red colour reflected from the stator plane. Although the predominant red of this picture may not have a direct symbolic significance Malina was probably thinking of the intense heat that emanates from a rocket motor during a space flight. This picture as so many kinetic paintings already shown at the one-man exhibitions at the Furstenberg Gallery, rue de

Furstenberg, Paris, and the Schwarz Gallery in Milan in 1961, underlines Malina's new aesthetic concern with studies of multicoloured orbits.

Jean Cassou has felt that in his lumidyne pictures Malina has achieved a successful fusion of his favourite subject-matter with the formal elements when writing : " Le spectateur assiste, dans ces petites caissettes accrochées au mur comme des tableaux, à un jeu, plus ou moins rapide de combinaisons stellaires, à un scénario céleste, à toute une comédie amoureuse de points et de lignes d'une essence insolite, où la lumière et la couleur se confondent en une substance, en une chair que nous appellerions volontiers angéliques . . . "

The present visual researches of Malina, although he is still continuing to make pictures with the lumidyne system, are mainly concerned with the reflection of light. He has developed the "reflectodyne" system which has considerably changed his artistic attitude. The fact that he is no longer employing paint on static or rotating surfaces, but that a surprising variety of forms is almost spontaneously created and has then to be controlled and directed by the artist, has changed the order of creation and puts into a new context such important problems as the relationship between the subject-matter and its formal expression. Previously Malina started out with a definite visual and emotional experience, so that he could speak without difficulty of the " subject-matter " of his picture and could give it unhesitatingly a title. Now he is faced with a welter of forms which take on their " subject-matter " slowly and the title for the reflectodyne pictures is only found at the term of this creative process.

On the purely technical level the new reflectodyne system is composed of four elements : the light source, a colour wheel, reflecting surfaces and a diffusing screen.

The light in this system is projected from one side of the picture and then passes through the colour wheel driven by an electric motor. This light is then reflected onto the diffusing screen by polished surfaces or mirrors. The movement is introduced into this type of picture by making some of the reflecting surfaces turn by an electric drive, for example mobile multiple mirrors reflect the light onto the diffusing screen as well as indirectly via the backboard. A great variety of forms and movements can be produced by the different possibilities of colouring the reflecting surfaces themselves and so multiply the chromatic effects as well as the design of the reflected forms. A further way of influencing the general composition is to deform the polished aluminium surfaces that serve as "mirrors" and thereby give different light intensities to the reflected lines, the angle of deflection having considerably changed in the different portions of the reflecting surfaces.

The fact that in composing his pictures Malina could exchange whole components is another notable feature of the reflectodyne system. The lumidyne system had already lent itself to certain transformations, but the changing of component parts in the reflectodyne pictures is much more elaborate since these parts could be produced in quantity like gramophone records.

The reflectodyne system gives a completely new " objet d'art " and has no longer the characteristics of a framed picture. It is a " box ", in the form of a television set, since a certain depth is needed to house the various component parts producing the different reflecting effects.

These boxes remain on the " human " scale and are earmarked for the intimacy of the home rather than for the cinema or public places. The diffusing screen, that could also be coloured, black or blue, becomes a real pictorial surface or image plane. The whole attention of the observer is now concentrated on this element of Malina's constructions and the mechanical elements are less noticeable.

It is rather paradoxical that Malina in this new expression is much closer to more traditional constructions such as Wilfred's " **Clavilux** ".

What has induced Malina to conduct his researches now mainly with the reflectodyne system is not only the fact that with the turning colour wheel he can determine any hue and any pattern of colour, but especially that the reflection system allows him to explore movements and rhythms different from those of the lumidyne system. In spite of some predecessors he does so in a very personal way and he exploits the fact that in addition to the vertical axis he may now use also a horizontal axis for his movements. Moreover rotary movement can now be shown anywhere on the viewing screen. Whereas in the lumidyne system the cycle recurred in one to two minutes, in the reflectodyne system there are two cycles : a cycle for the recurrence of the shapes and another one for the colours. Before a complete cycle of forms and colours is completed, i.e. before exactly the same picture returns, a time between twenty minutes and several days may elapse. The new creative process consists in starting with a great profusion of elements and reducing them gradually until a varied spectacle is composed that can be followed by the attentive observer. Another task for the artist is to fix the rate of movement within these cycles. This speed of change, adjusted to the human perception is one of the factors that causes the uniqueness of each of the completed reflectodyne pictures.

One of the more surprising results of experimenting with new aesthetic elements according to a " system " is to find that the finished works are so considerably different from one another and have almost started their own individual lives.

At the moment of writing these lines several very different reflectodyne " boxes " exist but are still subject to transformations and modifications. This is also one of their great attraction from an aesthetic point of view, since the impression persists that forms and subject-matter are in continuous evolution.

A reflectodyne picture provisionally named " **Dance** " was given a subject-matter in a voluntary way. Malina was watching his proper creation for hours and was rather baffled by the fact that it was producing shapes and movements which he had never seen before in nature. While architectural forms, light beams and complex mobile shapes that resembled waves were turning in an almost endless cycle, Malina cut out some human figures in cardboard or paper and fixed them to the polished, light-reflecting surfaces. This experiment yielded some recognizable human forms or silhouettes that recurred in different and quite unexpected combinations, giving his picture a thematic substance which corresponds to one of Malina's basic aesthetic aims.

Before this voluntary act of what one could call a figurative need, the closest comparison gave only a feeling of a geometrical landscape superimposed upon a complex light pattern.

Malina is finding great difficulty in adapting himself to the great profusion of psychological and aesthetic reactions that follow the use of the new technique. However, it is just this profusion and possible interpretation on different levels that is so fascinating and imposes on the artist the necessity to fix the limits of his creation, while at the same time inducing him to continue the creation by modifying various elements until an aesthetically satisfying result is obtained. The composition is again comparable to a musical creation, but resembles also to the painter's transformation of his picture, a single stroke of the brush altering sometimes the whole composition. As compared with the lumidyne pictures the " **Dance** " adds to the stroboscopic surprise effect often a strong intimate and poetic appeal.

But the new reflectodyne system opens up further great possibilities because music and sound can easily be integrated into this type of picture.

In fact, at the time of writing, Malina is engaged in serious researches for adding sound to his reflectodyne pictures.

The problem is a difficult one since many attempts at finding a close correspondence between colour and sound amplitude or timbre have failed. The colour organs of the Baroque and up to the 19th century were generally either purely theoretical inventions or single constructions representing entirely personal interpretations. They never established themselves as a separate art expression. The reason was probably that no direct objective connection exists from an aesthetic point of view between the colour and sound frequencies and intensities. We have already mentioned that a new approach was tried at the beginning of our century by the Russian composer Scriabine whose Prometheus symphony was accompanied by coloured light beams that were projected on a screen. The projecting surface, however, was not large enough to produce a spectacle in harmony with a symphony orchestra. Ever since new experiments were tried, mainly based on making the visual and the auditive rhythms to correspond rather than to find narrow equivalents between the components of vision and sound. Even with the most modern inventions, such as perfected photo-electric cells, cathode-ray tubes, and other devices used for television and in cybernetics, a considerable number of experiences will be necessary before an aesthetically interesting blending of elements such as frequency (or amplitude), intensity, overtone structure and " envelope " (viz. growth, duration and decay) of the sound structure with the visual elements, such as colour saturation, light intensity and frequency, lines and outlines (forms) could be achieved, and the problem of parallel composition really be envisaged.

The most immediate experiments of Malina in this field, similar to other researches like Nicolas Schöffer's, the French sculptor of Hungarian origin, or of certain Russians and Americans, is directed towards a first synthesis between the two sensorial experiences, by unifying the rhythms. The possibilities of application on a wide scale of the art of light reflected from surfaces and, if possible, combined with corresponding musical or other sound experiences have led Malina to found the Electre Lumidyne International, a Paris company whose aim it is to investigate the possibilities of applying kinetic art to decoration and advertising. In this research Malina is aided by painters like Vic Gray, a New Zealander, Nino Calos an Italian, and Reggie Weston from England. In fact the application of this art is of almost unlimited range and there is little doubt that its use should become as important as the reproduction-phenomenon in pictorial art as soon as it is realized that its introduction not only in public places such as airports, but also in waiting-rooms of professionals, or private homes is quite feasible.

Of course one could imagine all sorts of other more fantastic applications, such as in clothes as suggested by Jacques Bergier and it is amusing to note that an American dentist has already installed a similar box in front of his patient's stool with apparently very soothing results.

In any case the versatility, ingeniousness and universality of Malina's present-day researches are such that since 1953 he has not abandoned any of his principal art experiences, but has rather found ways of diversifying them. For example, he has continued making pastels and gouaches. Other small pictures are in oil paint on paper, while different techniques include varnish, enamel paint, glue, sponge, and wax. These pictures continue to elaborate the subject-matter of invisible or visible science phenomena such as shock waves, stream flows, rocket movements or surveying instruments. They are independent entities and cannot really be regarded as sketches to the kinetic pictures. This is a further indication that Malina intends to remain a painter while employing the most modern techniques and to safeguard his creative integrity with regard to the applications of his art.

Conclusion

A description of the personality and work of Malina and their interpretation ought to be completed by a study of the problems raised by his art.

These problems are so numerous that we cannot discuss them entirely within the scope of this work. However we shall attempt to touch on the major topics by making the artist give his own opinions.

The introduction of real movement and artificial light is the most striking as well as the most debatable and debated aspect of Malina's works. The presence of these technical elements and the "realistic" content of his pictures taken from observations and meditations in the physics field focus our attention on the interplay between Science and Art, just as the life of Malina is oscillating between these two poles.

Is it possible in the case of artist-scientist Malina to pronounce the word metaphysics? He would certainly be shocked to hear his activity associated with such a notion. Yet if it is true that metaphysics thrives on artistic and scientific experiences the introduction and manifestation of light must have a significance beyond the mere utilization of a modern element, particularly adapted to metamorphoses and their artistic exploration. Without having to go back to Plato or Plotinus a modern scientist like Niels Bohr believes firmly that light represents a fundamental truth and that light is nothing less than life itself. Similarly without returning to the opposition between Parmenides's absolute stability and Heraclitus's absolute flux, nor to Plato's or Aristotle's conception of this problem we refer us to the opinions of eminent modern scientists like Heisenberg who believe that beyond the simple explanation and utilisation of movement and its artistic appreciation there lies a metaphysical essence of movement.

With these remarks in mind concerning the two principal aspects of Malina's art we can approach the problem of the relationship between science and art.

Since Einstein, we are faced with an interesting aspect of modern atomic physics: the idea of complementarity. Science has had the tendency to reduce everything to a single element, yet every day new forms and even new elements are being discovered. We are in a world of potentiality and possibility, and the idea of complementarity in art and science is a metaphysical one, based on the metaphysicians' conviction that a single experience, a single thesis can never be satisfactory.

The problem of movement has since prehistoric times occupied the mind of the artist. Certain periods put more stress on it than others and emphasis was laid on it for different reasons connected with ideas ranging from the mere representation of the animals or the human beings' muscular movement to abstract ideas such as dynamism, the technical revolution or modern progress.

Malina sees in movement an aspect of life, an aspect of our time. An observer in front of a two-dimensional surface or static sculpture shows after a certain time a lowered interest, and continuous movement should keep his interest awake. This is one of the crucial points of his research: how to keep the observer in a state of aesthetic enjoyment and expectation. This is also the reason why Malina tries to find the longest possible cycles and even infinity in the changing forms and colours and in the very nature of the movements. In this connection it is also interesting to know that Malina gives as his first and foremost reason for introducing "real" movement into his pictures plain curiosity, which he describes as a deep human trait. This scientific and artistic curiosity he manages to communicate to the observer.

On the other hand Malina thinks that the artist's function is to respond to certain kinds of forms in his time. He invents forms, since nothing in nature corresponds exactly to the movement of his forms on the screen. Yet he says a flame or a fire comes close to this changing spectacle.

To the classical objection of traditional painters maintaining that there is already enough movement, and more subtle, intimate and poetic movement at that, in the subject or especially in the case of " abstract " painters in the disposition of the masses, the lines of force, the oppositions of colours or the tension of lines, Malina replies that " movement like colour is a fact ". It would be like tying one's hand behind one's back if one did not use this important element in the plastic arts. In fact through movement a new and different art from painting is instituted and can no longer be compared with the other arts in this narrow way. With movement you can even make objects and give totally different illusion of depth.

The crucial point here is of course whether the aesthetic imagination is activated or dulled by real movement. Malina thinks that kinetic art is the best way to communicate the fascination of the movement of the sea, the fire in the fire-places, fish in an aquarium, the vibration of leaves or even the movement of clocks to the observer. As to the subject-matter of movement, taken from different manifestations in nature such as satellites, points of moving light could remind one of this and it is therefore a legitimate means for an artistic representation of it. Another particular interesting aspect of actual movement in pictures is of course the testing of the human capacity to follow psychologically and aesthetically a certain rhythm. The artist first of all has to limit the speed. If his kinetic picture changes too rapidly a disagreeable effect is produced, whereas too slow a movement will draw the observer's attention to the mechanical phenomenon and the movement of forms and colours will be forgotten and make the observer think of a lit-up picture. Malina says on this point that the range of movement is to be limited just as colours are limited by the violet and red extremes of the spectrum.

In any case the movement itself will produce some kind of experience, and this experience will be at the same time scientific and aesthetic. It can be compared to a musical experience or called metaphysical but will be a complete rhythmic experience with analogies to the rhythm of modern life both in its technical and aesthetic aspects.

Towards the idea that a real synthesis between science and art is possible Malina is sceptical. He wants to bring to the observer the new kind of world one is finding with a scientific method and which remains generally unseen by the naked eye. For him science gives a kind of vision which the artist then tries to translate or give an illusion of by all kinds of techniques. He does not think that detailed precise scientific knowledge would help an artist to re- present and depict certain phenomena in nature that seen to him important.

As to the " scientific " attitude the eternal discussion as to whether this means an objective or subjective approach has not ceased and will probably never do so.

In the case of Frank Malina there is little doubt however that apart from his main object: that of depicting or transforming scientific subject matter and emotions into artistic representations and techniques, he combines a deep sensitive individuality that seeks a direct, spontaneous expression with the cool, experimental approach of the scientist which give his " pictures " their particular quality and through this association transcend reality and fascinate the spectator.

Beyond all technical innovations and the meaning of such abstract terms as artificial light or actual and continuous movement, it is finally in the artist as a human being that we find the answer to these problems and a significant synthesis between the scientific and artistic aspects of our universe.

It is on this human level and through the multiple achievements accomplished during the course of Malina's life that we discover the secret of his originality.

Paris, 1963

(This monographic study written in 1963 is published in the year 2000 without any modifications)

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